PATENT SPECIFICATION

(11) **1312560**

DRAWINGS ATTACHED

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(19)

(54) TREATING NON-WOVEN FABRICS

(71) We, MONSANTO COMPANY, a corporation organised under the laws of the State of Delaware, United States of America, of 800 North Lindbergh Boulevard, St. Louis 66, State of Missouri, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for selectively reducing the air permeability of non-woven fabrics and, more particularly, to a process applicable to autogenously bonded nylon non-woven fabric.

The invention comprises a process for the reduction of air permeability of a non-woven fabric formed from autogenously bonded nylon filaments having a fabric weight of not more than 2 oz./square yard, which comprises subjecting the fabric to a calendering operation at a temperature and pressure sufficient to reduce its air permeability, the fabric after calendering having an air permeability in the range of 1 to 100 cubic feet per minute per square foot measured at a differential air pressure of 0.5 inch of water.

By selectively applying heat and pressure to the fabric, the air permeability can, as has been indicated above, be reduced to a very low level. In general, the most suitable conditions are found to be a temperature of from 300 to 400°F. and a pressure per linear inch of calender roll width of from 1000 to 2000 pounds. The conditions are selected such that no substantial fusion of the nylon filaments occurs, and preferably the temperature of the calender rolls is below the melting point of the nylon filaments.

In a preferred process the calendering is done by passage of the fabric through the nip of a pair of pressure rolls, one of which is a heated incompressible roll and the other of which is an unheated filled roll.

The nylon filaments comprising the fabric to be processed are autogenously bonded at a substantial number of touching filament cross-over points to provide multi-directional dimensional stability. The strength of the bond approaches the strength of the nylon filaments comprising the web so that a force exerted on one portion of the fabric will be propagated throughout the fabric to a significant extent. "Autogenously bonded" means that the bonds between the filaments are formed in the absence of an external binder. For example, two filaments may be autogenously bonded together by the application of heat in that the filaments are fused at the cross-over points. Autogenous bonding also includes the use of solvents since upon the removal of the solvent from the filament, the polymers comprising the filaments are mixed at the filament cross-over points. However, the preferred method for autogenously bonding nylon filaments is set forth in U.S. Patent 3,516,900. This method employs a hydrogen halide gas, and more particularly, hydrogen chloride gas to effect bonding. The filaments absorb the hydrogen chloride gas along the surface areas which results in the breaking of the intermolecular hydrogen bonds between adjacent amide groups. Upon desorbing of the hydrogen chloride from the nylon filaments, the intermolecular hydrogen bonds between amide groups of different filaments reform, resulting in bonding at interfilament cross-over points. Desorption can take place either by immersing the fabric in water or by heating the fabric to temperatures higher than 110°F.

While the nylon filaments comprising the fabric may be completely undrawn, partially drawn, or completely drawn, it has been found that partially drawn filaments most effectively respond to the process of this invention. The tensile strength of partially drawn nylon filaments is substantially greater than the tensile strength of undrawn nylon. Also, undrawn nylon filaments are frequently too plastic to be readily calendered by the process of this invention. Completely drawn nylon filaments are often too rigid to be calendered and in such cases the resulting fabric would not res-

pond to the process of this invention with any substantial success.

The non-woven fabric that is calendered according to the process f the invention may be formed of filaments of any polyamide (nylon). Particularly good results are obtained with nylon 6,6.

One of the calender rolls is normally made with a hard incompressible surface which is also heated. This roll may be made of alloy steel, plastic, ceramic or coated with a metal such as chromium or nickel.

The surface is preferably rust resistant. The second roll is preferably of an unheated filled roll which can be made of a compressible composition such as, cotton, paper, wool, corn husk or other material that will represent a tough, resilient surface to the fabric when compressed against the first roll.

In the accompanying drawings:

Figure 1 is a diagrammatic flow sheet of the process of the present invention;

Figure 2 is a schematic representation of an embodiment of the process of this invention;

Figure 3 is a graph showing the advantages of a spunbonded nylon fabric over other fabrics when subjected to the process of this invention.

Figure 4 is a draftsman's conception of a photomicrograph of the fabric prior to treatment; and

Figure 5 is a draftsman's conception of a photomicrograph of the fabric having been subjected to the process of this invention.

Referring to the first and second stages shown in Figure 1, continuous nylon filaments are spun from a melt extruder. The formed filaments are then drawn downwardly away from the extruder by a pneumatic aspirator which also deposits the filaments by means of moving air on to a conveyor belt. The nylon filaments comprising the fabrics can then be bonded together to form a coherent fabric by being passed through a chamber containing hydrogen chloride activating gas. The nylon filaments absorb the hydrogen chloride gas which renders them bondable upon the removal of the gas. Thus, the filaments are permanently bonded together at a substantial number of touching filament cross-over points by having the gas desorbed from the filaments by either heat or water means.

With reference to Figure 2, fabric 11 manufactured by the above described process is passed between calender rolls 12 and 13. The pressure exerted on fabric 11 is typically from 1000 to 2000 pounds per linear inch. Roll 12 is shown as a solid steel roll and is heated to a temperature which is typically in the range 300 to 400°F. by any common means such as gas or by electrical means. Roll 13 is provided with a steel core 15 and a compressible exterior made from cotton.

With reference to Figure 3, air permeabilities of four fabrics were measured over a range of temperatures from about 300 to 400°F. The pressure rolls were set to deliver 2000 pounds per linear inch of force on the fabric. One and two ounce Cerex were compared with Reemay, Pellon and a continuous filament nylon web bonded with an acrylic latex binder. Cerex is the registered trademarke of the Monsanto Company identifying the spunbonded non-woven nylon fabric of this invention. Reemay is a trademark of I. E. DuPont de Nemours Co. and identifies a spunbonded fabric made of continuous polyester filaments bonded by heat means. Pellon is a non-woven fabric comprise of staple length nylon and regenerated cellulose fibers bonded together with a silicone latex binder. Pellon is the product of the Pellon Corp. of New York, New York. Prior to be calendered, by the process of this invention, one ounce Cerex had an air permeability of 514 $ft^3/min/ft^2$ and the two ounce fabric had an air permeability of 406 $ft^3/min/ft^2$, measured at a differential air pressure of 0.5 inch of water. Reemay at one oz/yd^2 had an uncalendered air permeability of 753 $ft^3/min/ft^2$; the nylon 6,6 spunbonded fabric with the acrylic latex binder at 1.8 oz/yd^2 had an uncalendered air permeability of 1022 $ft^3/min/ft^2$; and Pellon had an air permeability of 274 $ft^3/min/ft^2$ at 2 oz/yd^2. It can be seen that the other non-woven fabrics cannot be reduced in air air permeability to the degree to which the spunbonded nylon fabric of this invention can be reduced, either because the filaments do not lend themselves to deformation at the given temperatures and pressures or because the filament binder system prevents such filament deformation. While it is obvious that the air permeability of the other fabrics may be decreased by either increasing the roll temperature of increasing the pressure on the fabric, the increase in pressure on the fabric is not economically feasible and at temperatures hgher than 400°F., the filled roll which is necessary to control air permeability accurately begins to char and will eventually burn.

WHAT WE CLAIM IS:—

1. A process for the reduction of air permeability of a non-woven fabric formed from autogenously bonded nylon filaments having a fabric weight of not more than 2 oz./square yard which comprises subjecting the fabric to a calendering operation at a temperature and pressure sufficient to reduce its air permeability, the fabric after calendering having an air permeability in the range of 1 to 100 cubic feet per minute per square foot measured at a differential air pressure of 0.5 inch of water.

2. A process according to Claim 1, in which the fabric is formed from partially drawn, continuous, nylon filaments.

3. A process according to either of Claims 1 and 2, in which the fabric is calendered

at a temperature of from 300—400°F. and a pressure (per linear inch of roll width) f 1000 to 2000 pounds.

4. A process according to any of Claims 1 to 3, in which the calendering is done by passage of the fabric through the nip of a pair of pressure rolls, one of which is a heated incompressible roll and the other of which is an unheated filled roll.

5. A process for the reduction of the air-permeability of a non-woven fabric formed from autogenously bonded nylon filaments substantially as described with reference to Figure 2 of the drawings.

6. An autogenously bonded nylon non-woven fabric having a fabric weight of not more than 2 z./square yard and an air permeability of from 1 to 100 cubic feet per minute per square foot measured at a differential air pressure of 0.5 inch of water prepared by a process according to any of Claims 1 to 5.

7. An article fabricated from a non-woven fabric according to Claim 6.

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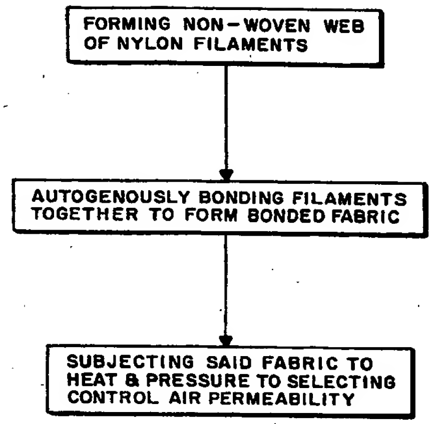
FORMING NON-WOVEN WEB OF NYLON FILAMENTS
AUTOGENOUSLY BONDING FILAMENTS TOGETHER TO FORM BONDED FABRIC
SUBJECTING SAID FABRIC TO HEAT & PRESSURE TO SELECTING CONTROL AIR PERMEABILITY

FIG. 1.

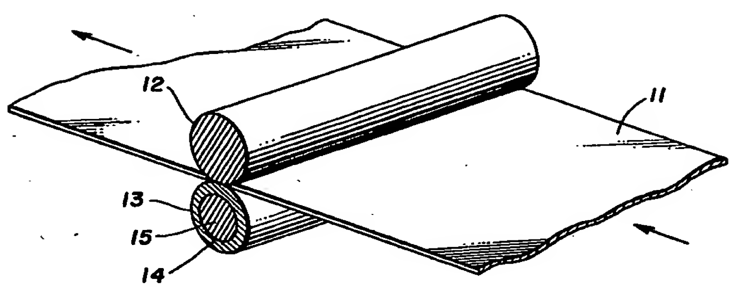
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FIG. 2.

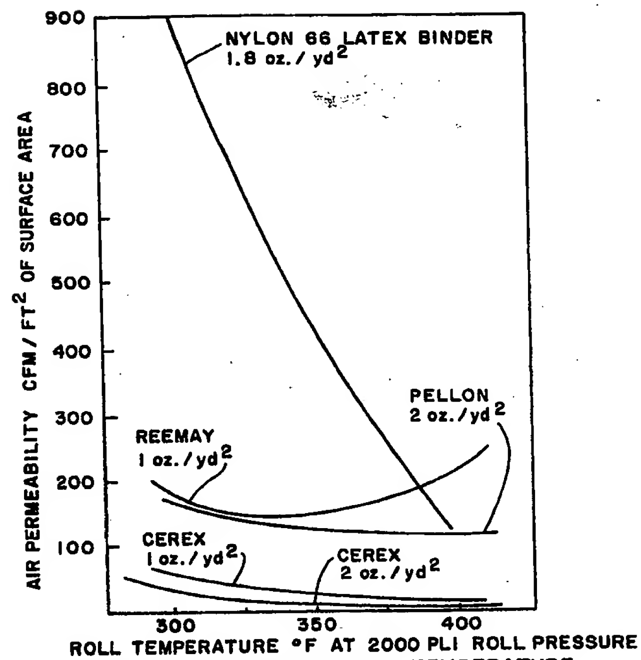

FIG. 3.

AIR PERMEABILITY VS ROLL TEMPERATURE

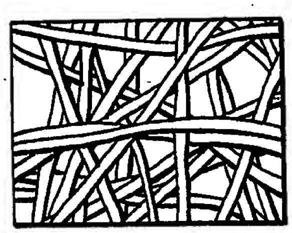

FIG. 4.

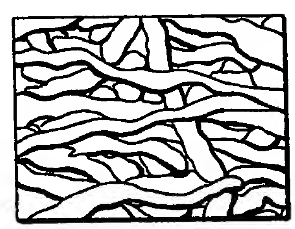

FIG. 5.